

General Disclaimer

One or more of the Following Statements may affect this Document

- This document has been reproduced from the best copy furnished by the organizational source. It is being released in the interest of making available as much information as possible.
- This document may contain data, which exceeds the sheet parameters. It was furnished in this condition by the organizational source and is the best copy available.
- This document may contain tone-on-tone or color graphs, charts and/or pictures, which have been reproduced in black and white.
- This document is paginated as submitted by the original source.
- Portions of this document are not fully legible due to the historical nature of some of the material. However, it is the best reproduction available from the original submission.

LARGE AREA CROP INVENTORY EXPERIMENT (LACIE)

Available under NASA sponsorship
in the interest of early and wide
circulation of Earth Resources Survey
Program information and without
for any one made thereof.



NASA NOAA USDA

7.9-10141

CR-158150

CAMS PHASE II FUNCTIONAL PROCEDURES

(E79-10141) LARGE AREA CROP INVENTORY
EXPERIMENT (LACIE). CAMS PHASE 2 FUNCTIONAL
PROCEDURES (Lockheed Electronics Co.) 40 p
HC A03/MF A01 CSCI 02C

N79-18406

Unclas
G3/43 00141



National Aeronautics and Space Administration
LYNDON B. JOHNSON SPACE CENTER

Houston, Texas
March, 1976

CAMS PHASE II FUNCTIONAL PROCEDURES

APPROVED BY:


F. G. Hall
CAMS Subsystem Manager


R. M. Bizzell
CAMS Operations Manager

MARCH 1976

ACKNOWLEDGMENTS

This document represents the work of personnel from Lockheed Electronics Company, Inc./Aerospace Systems Division, the National Aeronautics and Space Administration, and the U.S. Department of Agriculture. This work was performed under NASA contract NAS 9-12200.

TABLE OF CONTENTS

| Section | Page |
|---|------|
| 1.0 Introduction | 1 |
| 2.0 Functional Overview | 6 |
| 2.1 Input Requirements | 19 |
| 2.2 Output Requirements | 20 |
| 2.3 Intermediate Products | 21 |
| 2.4 LACIE Team Analysis Timeline | 22 |
| 3.0 Detailed Flow Charts | 23 |
| 4.0 Detailed Analysis Procedures Section Titles | 31 |
| 5.0 References | 36 |

1.0 INTRODUCTION

The overall emphasis of the CAMS Phase II functional procedures is to interact the total interpretation and classification processes by exploiting the capabilities of an analyst team. A team is comprised of an analyst interpreter (AI) and a data processing analyst (DPA).

Figure 1-1 depicts, in general, the CAMS functional flow for LACIE Phase II operations. It is convenient to consider Functional Block 1 of the diagram - the ISSRS-CAMS Interface for Imagery and Ancillary Data Function - as a starting point of the CAMS daily operation. It is here that the interface with LPDL (ISSRS) is established by obtaining the CAMS analyst packets, followed by verifying packet contents and distribution of packets for interpretation. The appropriate segments are selected for interpretation within this functional block through coordination with CAS and in accordance with established project priorities. The fact that backlogged segments will be scheduled for analysis based upon a priority represents a new function during LACIE Phase II. It is also anticipated that CAS will indicate to CAMS which segments need agronomist or regional analysis consultants in support of the data processing function within this functional block.

In general, the analysts will be assigned segments to be interpreted by considering both regional assignments and project throughput objectives. It is not anticipated that an analyst will be idle during a week of heavy data flow in support of regional assignment constraints. The regional assignments will be made as discussed in the CAMS Operational Plan for LACIE Phase II (Reference 1). The general analyst review and interpretation function occurs in Functional Block 2. Initially, the data will be screened by the analyst to determine if the data is suitable for interpretation in the sense that wheat is distinguishable, or if significant change in the proportion wheat from previously processed acquisition exists. In addition, the analyst again verifies, when possible, the location of the segment and quality of the PFC products.

Two new functions are anticipated for Phase II Operations in this functional block: (1) the analyst can declare a segment non-suitable for interpretation and notify CAS; and (2) the analyst may generate a cluster map for subsequent interpretation aid when a segment passes review. In general, in Functional Block 2, the processibility of a segment is determined.

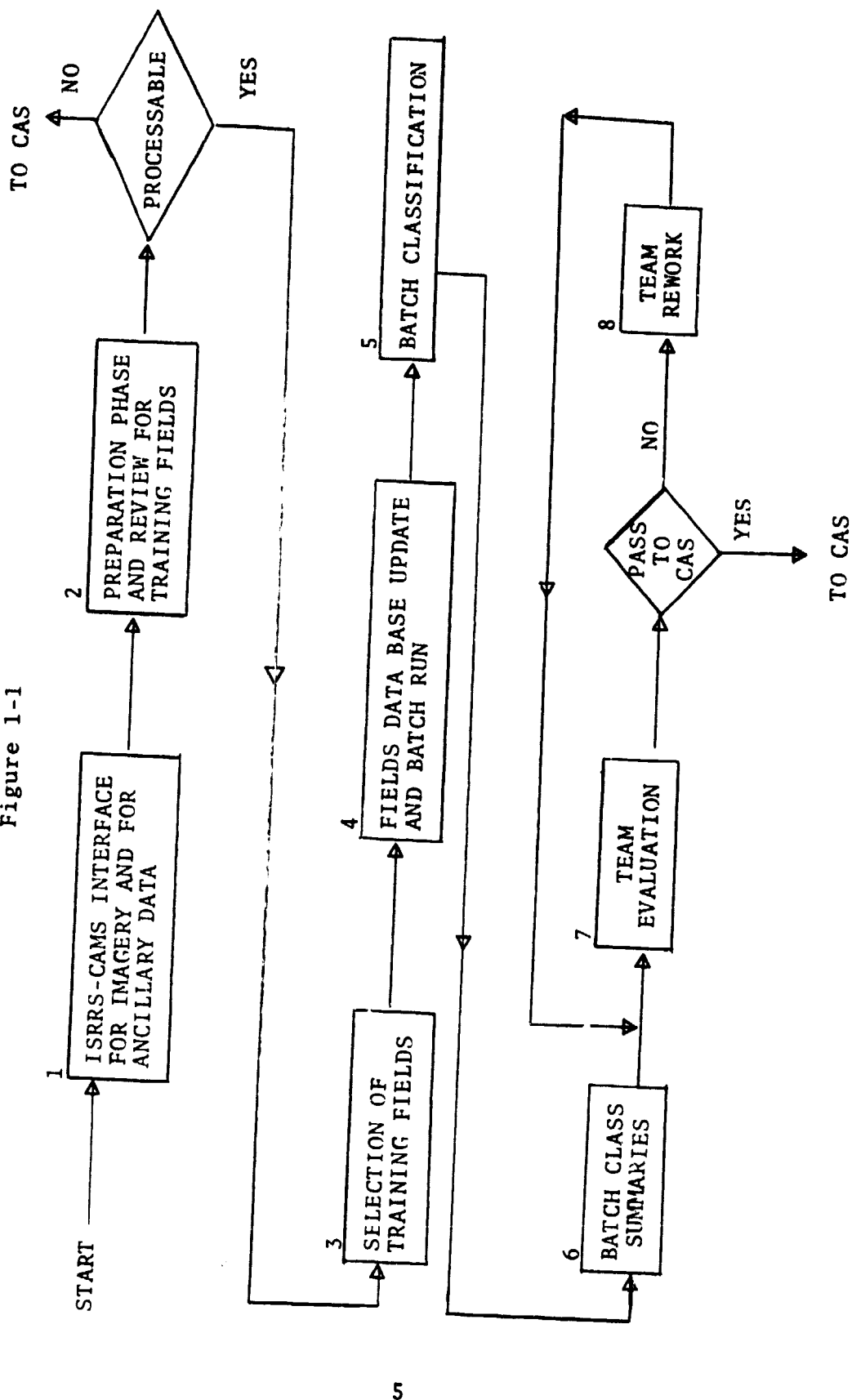
Functional Block 3, selection of training fields, requires the analyst to estimate the wheat biowindow to the nearest half unit and compare this estimate with the YES provided estimate. Previously acquired imagery, classification, and interpretations will be made available to the analyst for review references to improve performance. The analyst will estimate the segment wheat percentage and determine whether the segment should be classified and the appropriate classification run technique. This functional block includes the decision on the number of acquisitions necessary to adequately separate wheat. This pre-processing function is essential for effectively classifying a segment.

Functional Blocks 4, 5, and 6 describe the process of field data base update and batch run classification. These functions were implemented during LACIE Phase I operation except that the batch run deck will be generated at the LARS terminal in Phase II. This is anticipated to improve batch turnaround by at least one day.

The evaluation function (Functional Block 7), an existing function, will be performed by the analyst team instead of a separate evaluation group. The advantage of this change derives from the anticipated enhancement of the

analyst's sense of responsibility and satisfaction which, in turn, may increase the throughput rate as well as the overall quality. A second obvious advantage is the encouragement of a useful AI-DPA interface. The segment processing criteria have also been defined objectively. The analyst team will make the final segment evaluation or rework decision. The rework, depicted in Functional Block 8, will be basically carried out on ERIPS console using techniques such as multi-temporal classification, deletion of poor quality channels, changing of field boundaries, etc. The best classification results will then be forwarded to CAS.

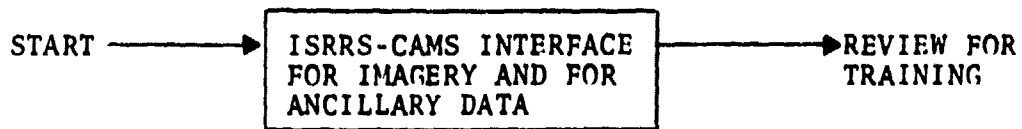
Figure 1-1



2.0 FUNCTIONAL OVERVIEW

This section expands each functional block to list the activities occurring in that function. The activities are not necessarily discussed in sequential order. The sequence can be determined from section 3.0, Detailed Flow Charts.

FUNCTION 1



- 1.1 Provide interface with ISRRS (LPDL) to acquire analyst segment packets on a daily basis.
- 1.2 Consult with OCC to maintain a regional data processing priority list coordinated with CAS.
- 1.3 Delivery analyst segment packets to teams for processing in accordance with CAMS operations plan.
- 1.4 Provide input to the ASATS (Automatic Status and Tracking System) specifying receipt of segment acquisitions by CAMS.

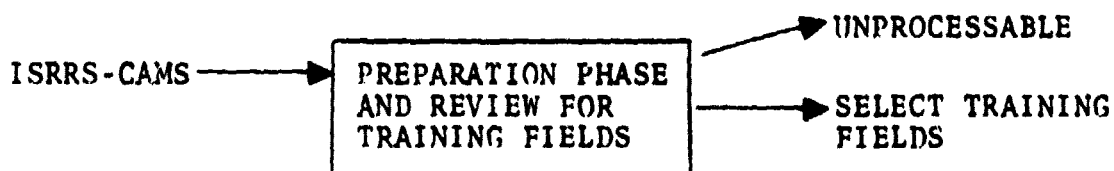
PRODUCTS

Analyst segment packet contains PCF products 1, 2, and/or 4; crop calendar; cropping practices form; historical crop statistics; topo maps with inventory sheet; real time met data; (cluster maps*).

Segment priority list from OCC; ASATS listing.

- * The cluster maps may be generated for aid in interpretation and verification; however, they are not currently being generated on every segment.

FUNCTION 2



- 2.1 Verify that all required contents of team packet are present.
- 2.2 Label imagery with required information.
- 2.3 Screen for data quality, e.g., data drop-out, poor PFC products, striping, etc.
- 2.4 Check imagery for clouds, haze, or snow.
- 2.5 Review ancillary data.
- 2.6 Interpret for emerged wheat, small grains, or significant signature change from previously processed acquisition.
- 2.7 If data quality unacceptable, file DR and return segment packet to LPDL.

FUNCTION 2 (Continued)

- 2.8 If clouds, haze, or snow are a problem, or if emergence of wheat is not evident, or if no significant change in signatures from previously processed acquisition exists, then reject for training field selection and notify CAS.
- 2.9 If segment passes review and cluster map is desired, code cards for dummy field in fields data base should no fields exist for the segment and code cards for cluster map generation and submit.

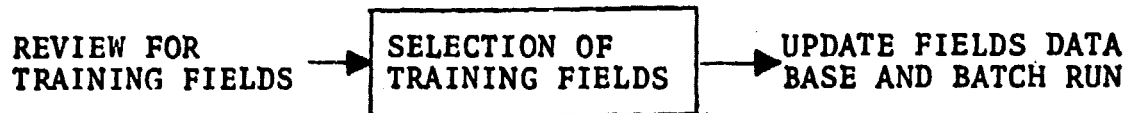
PRODUCTS

Function 2 includes: analyst packet, discrepancy report, Data Acquisition/Evaluation Record, computer coding sheets, data product request (DPR), previous results if any, and block of DPR numbers.

REFERENCE

Detailed Analysis Procedures, Section 2.1, Appendix A

FUNCTION 3



- 3.1 Assimulate ancillary data and imagery.
- 3.2 Verify temporal registration (on successive acquisitions).
- 3.3 Evaluate and estimate wheat biowindow number to nearest half of a unit (2, 2.5, 3, 3.5, etc.).
- 3.4 Determine if adequate amount of wheat exists; if not, count by hand, record on CAMS evaluation form, and pass to CAS.
- 3.5 Select processing mode (single pass, multitemporal).
- 3.6 Select signatures from current acquisition for identification by reviewing imagery and previous classifications and interpretations, and update selected set of signatures for identification (if previous results are available). If not, select signatures based on imagery and ancillary data (including cluster maps).

FUNCTION 3 (Continued)

3.7 Select training and test field boundaries for signatures to be used.

3.8 Label training fields as wheat, small grains, etc.

3.9 Annotate temporal crop form and add to segment packet.

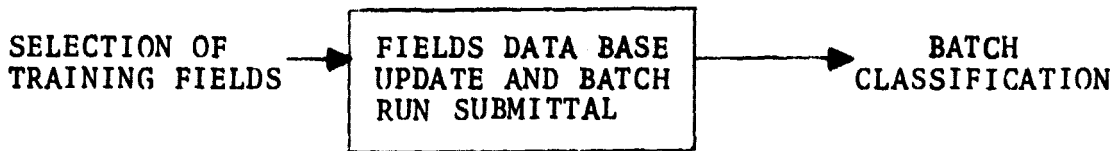
PRODUCTS

Analyst packet with cluster map (if available), CAMS evaluation form, and temporal crop form.

REFERENCE

Detailed Analysis Procedures, Sections 2.2, 2.3.1, 2.3.2

FUNCTION 4



- 4.1 Mark training field corner coordinates on Del Foster and generate DEAF deck.
- 4.2 Reformat DEAF deck on LARS terminal and obtain listing for verification.
- 4.3 Obtain field boundaries map from LARS terminal for verification.
- 4.4 Generate classifier batch run deck on LARS terminal.
- 4.5 Fill out DPR's and pass fields data base update deck and batch run deck to ISRRS (LPDL).

PRODUCTS

DEAF deck, fields data base update deck, field boundaries map, batch classifier deck, DPR's.

REFERENCE

Detailed Analysis Procedures, Section 2.3.3

FUNCTION 5

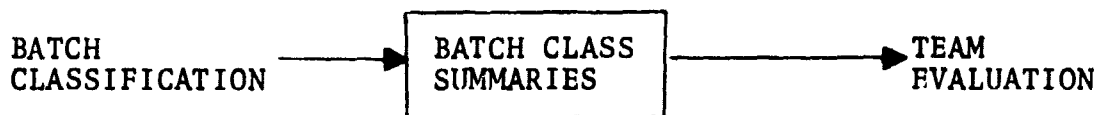


This function is performed outside Bldg. 17, but is flagged because numerous products for CAMS are generated in this function.

PRODUCTS

Product 12 (fields data base overlay for each update of the data base), Product 8 (Black-and-white classification map), microfiche listing of statistics and classification summary, COM results tape.

FUNCTION 6



- 6.1 Obtain COM tape number from OCC daily for all batch jobs processed during previous 24 hours.
- 6.2 Obtain appropriate COM tape from Bldg 30 I/O room and submit with processing deck to Bldg. 12 UNIVAC 1100's.
- 6.3 Pick up results in Bldg. 17 next day. Results constitute a hard copy of the batch classification summary and a summary of the classification summary for each batch processed segment.
- 6.4 Distribute results to teams.

PRODUCTS

COM tape, processing deck, classification results.

REFERENCE

Detailed Analysis Procedures, Section 3.1.

APPROVED:

DATE:

*Rmb**7/15/76*FUNCTION 7BATCH CLASS
SUMMARIESTEAM
EVALUATIONCAS OR
REWORK

- 7.1 Screen for classifier run mistakes.
- 7.2 Screen statistics for irregularities such as large standard deviations, and record inconsistencies on CAMS evaluation form.
- 7.3 Compare classification maps with fields defined on PFC Product 1 to check for misidentified fields and general agreement with imagery. Record results on CAMS evaluation form.
- 7.4 Evaluate complete data and determine evaluation code according to established criteria.
- 7.5 Make acceptance or rework decisions, then record results on CAMS evaluation form.
- 7.6 Record the necessary data on the Data Acquisition/
Evaluation Record.

FUNCTION 7 (Continued)

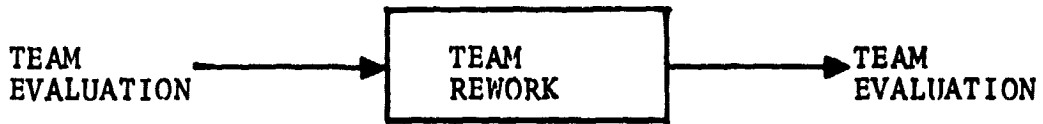
PRODUCTS

Classification results, including all data in analyst segment packet, hard copy results from COM tape, PFC Products 8 and 12, and microfiche of STATS and class summaries, CAS evaluation code, CAMS evaluation form.

REFERENCE

Detailed Analysis Procedures, Section 3.4.1, 3.4.2, 3.4.3, 3.4.4, 3.4.7

FUNCTION 8



- 8.1 Make appropriate corrections based on batch run results and reclassify batch or on ERIPS console using techniques such as multitemporal classification, delete channels, change fields, etc.
- 8.2 Obtain classification results when decision is made that best results have been achieved.
- 8.3 Calculate necessary numerical results as defined in Detailed Analysis Procedures.
- 8.4 Return to functional procedures in Function 7 and proceed with team evaluation.

PRODUCTS

Statistics and classification summaries from hard copy machine; gray shade class map from gray shade machine/paper delog from Bldg. 30, PFC Product 8.

REFERENCE

Detailed Analysis Procedures, Section 3.4.5, 3.4.6, 3.4.7, 3.2

FLOCON

FLOCON function is to provide overall CAMS data handling, scheduling, and status and tracking.

PRODUCTS

ASATS status and tracking data, console schedule, facilities utilization report, OCC reporting.

2.1 INPUT REQUIREMENTS

| <u>Product Required</u> | <u>Required From</u> | <u>Frequency</u> | <u>Format</u> |
|--|----------------------|---|---|
| Segment Priority Processing List | OCC | Daily | An up-to-date listing of segment processing priority for those segments available in LPDL |
| Analyst Segment Packet | ISRRS (LPDL) | Daily | Folder for each segment containing PFC Products 1, 2, and 4, crop calendar, cropping practices form, historical crop statistics, topographical maps, (cluster map, PFC product 9) |
| DPR Numbers | ISRRS (LPDL) | Daily | Block of DPR numbers |
| Batch Classification Results | ISRRS (LPDL) | Daily | PFC products 8 and 12, microfiche listing of statistics and classification summary, fields data base transaction report, COM results tape |
| Hard Copy of Statistics and Classification Summary | QA Bldg. 12 | Daily | Computer line printer listing of statistics and classification summary, batch scenario |
| ASATS Listing | Data Manager | Daily | Hard copy listing of segments' status |
| ERIPS Console Classification Results | ISRRS (LPDL) | Daily, if hard copy or gray shade machines are down | Hard copy of delog results and PFC Product 8 |

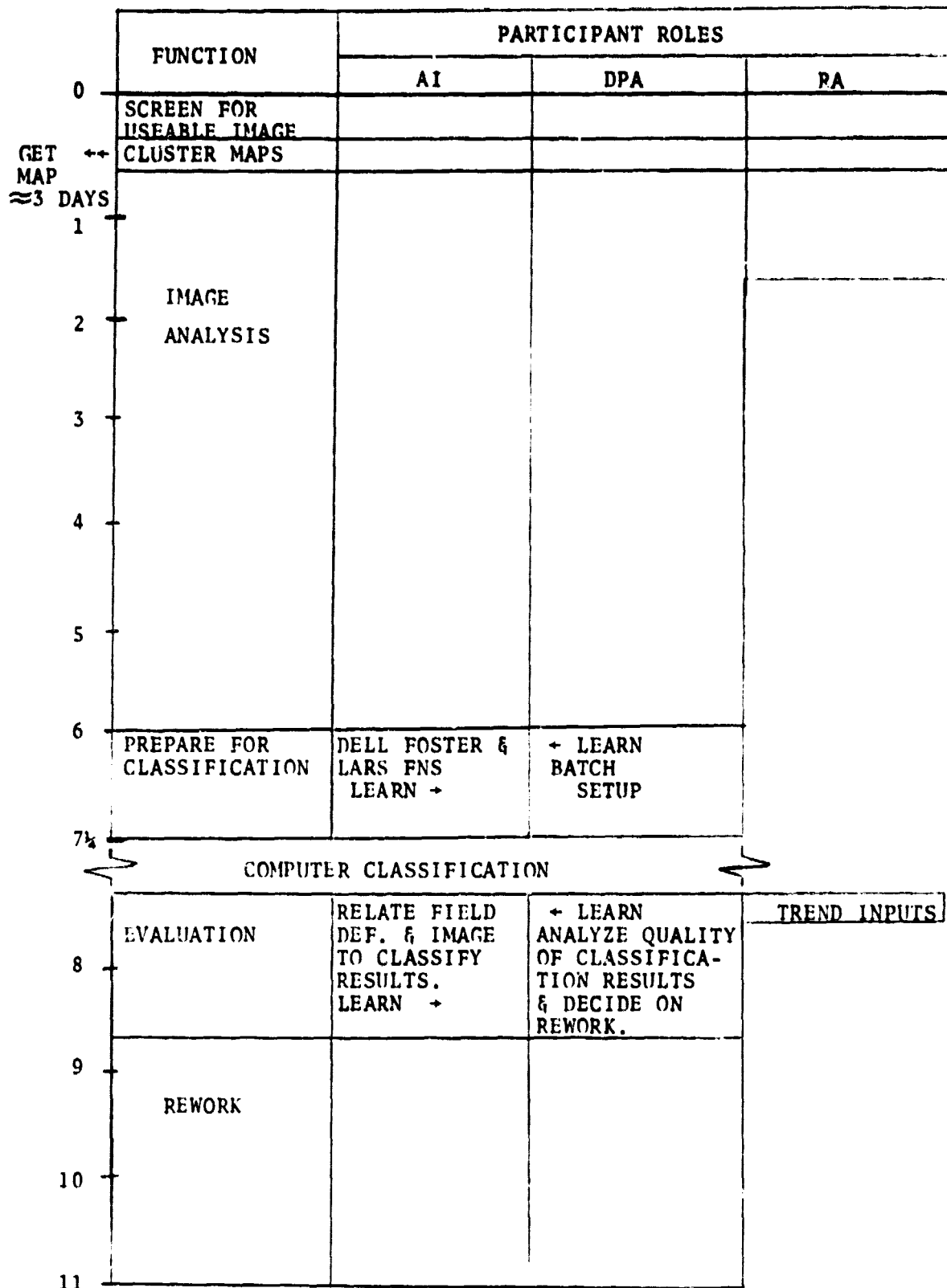
2.2 OUTPUT REQUIREMENTS

| <u>Product Description</u> | <u>To Whom</u> | <u>Frequency</u> | <u>Format</u> |
|-----------------------------------|----------------|------------------|------------------------|
| Discrepancy Report | ISRRS (LPDL) | As required | Standard Form |
| CAMS Evaluation Form | CAS | As required | Standard Form |
| Inputs for Cluster Map Generation | ISRRS (LPDL) | Daily | Computer Coding Sheets |
| Data Processing Requests | ISRRS (LPDL) | Daily | Standard Form |
| Fields Data Base Update Deck | ISRRS (LPDL) | Daily | Card Deck |
| Batch Classification Deck | ISRRS (LPDL) | Daily | Card Deck |
| Run Deck for/and COM Results Tape | QA Bldg 12 | Daily | Card Deck and Tape |
| ASATS Status and Tracking Info | Data Manager | Daily | Computer Coding Sheets |
| Facilities Utilization Report | OCC | Weekly | Batch and Console Use |

2.3 INTERMEDIATE PRODUCTS

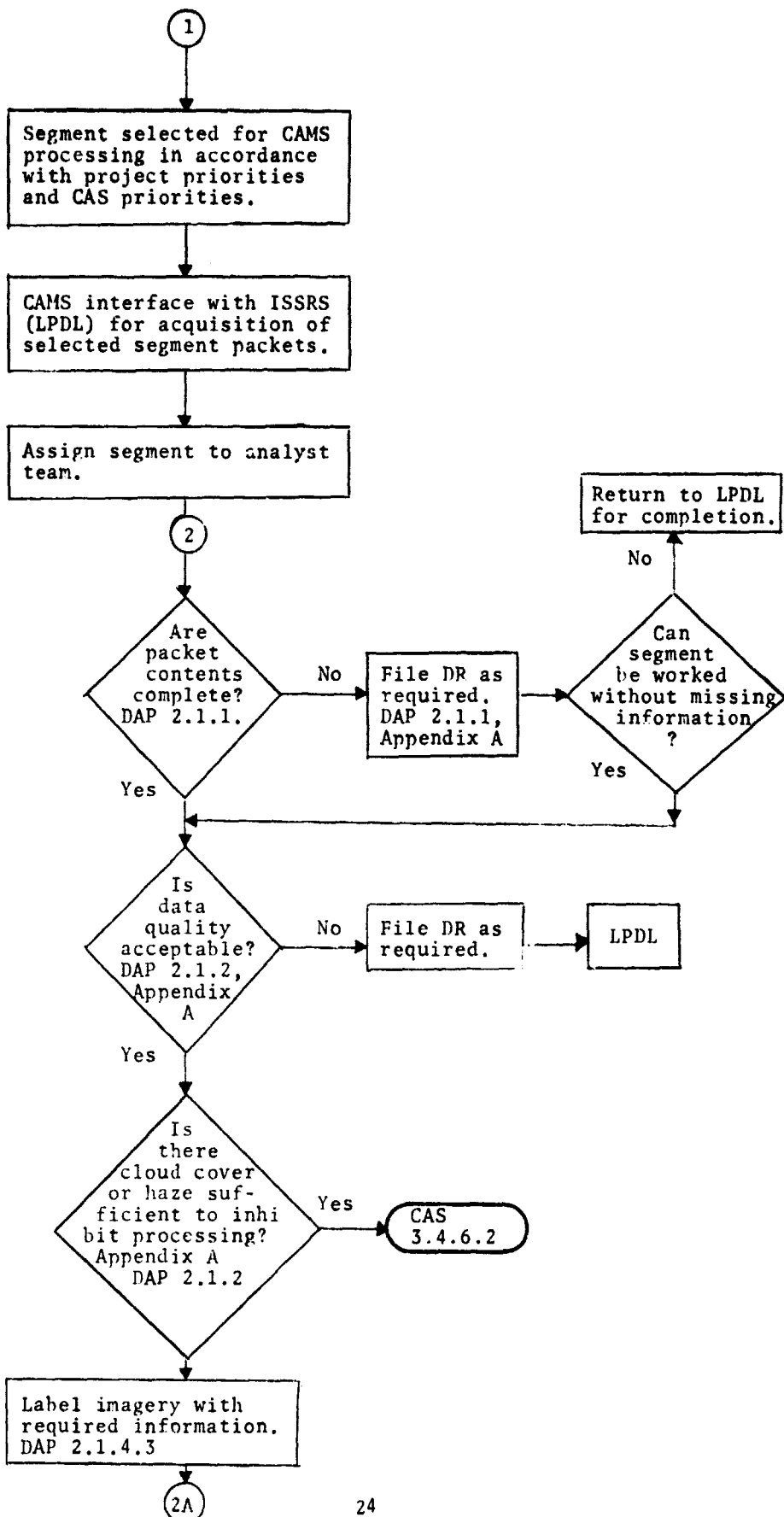
| <u>Product Description</u> | <u>Frequency</u> | <u>Format</u> |
|--|---|--|
| Temporal Crop Form | Daily | Standard Form |
| FLAP Deck | Daily | Card Deck from Del Foster |
| Fields Boundaries Map | Daily | Line Printer Map |
| ERIPS Console Classification Results | Daily, if hard copy and gray shade machines are working | Paper products containing menu listings, statistics and classification summaries, and gray shade classification maps |
| Segment Processing Status and Tracking | Daily | Format is being developed at present |

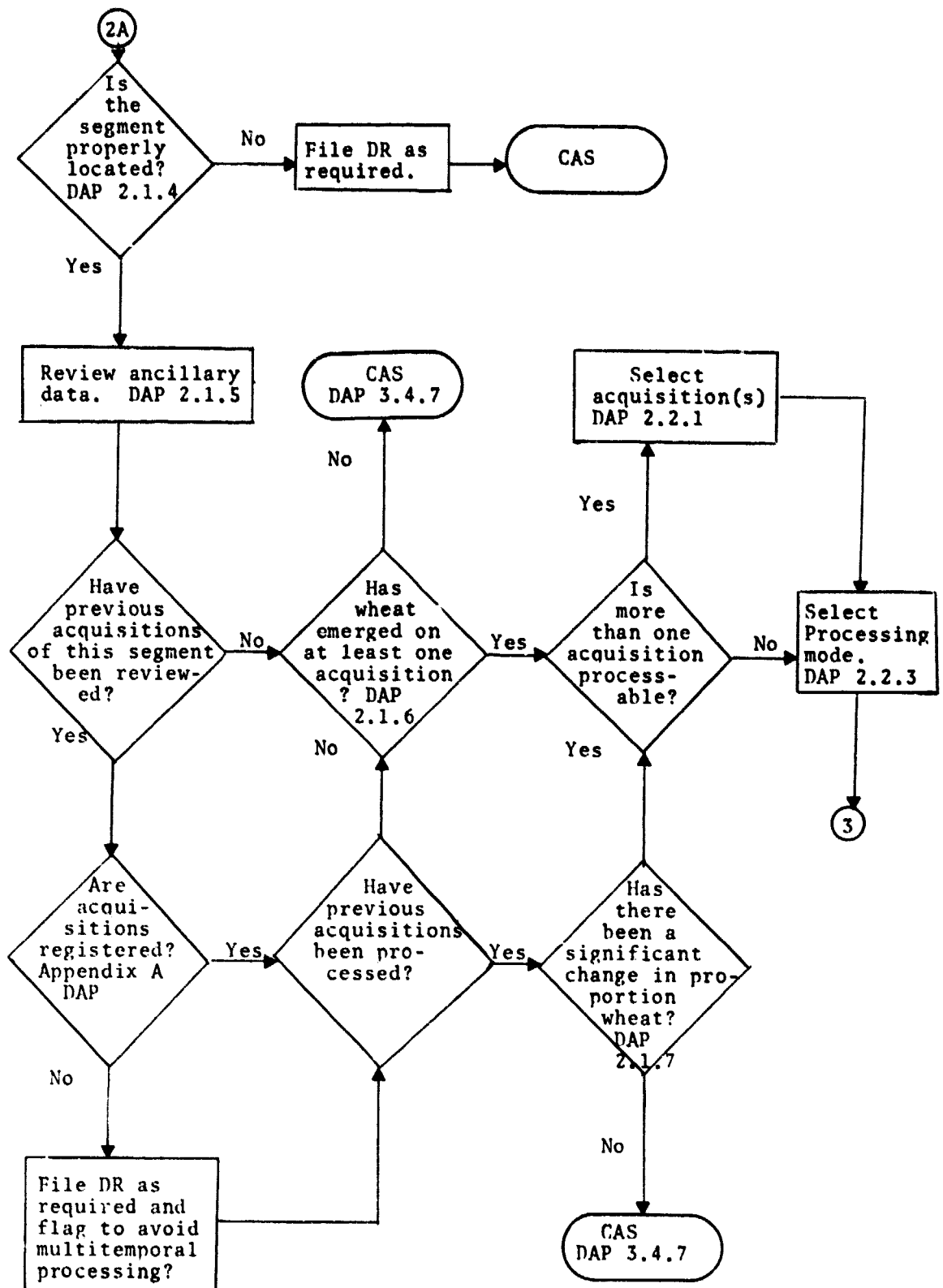
2.4 LACIE TEAM ANALYSIS TIMELINE

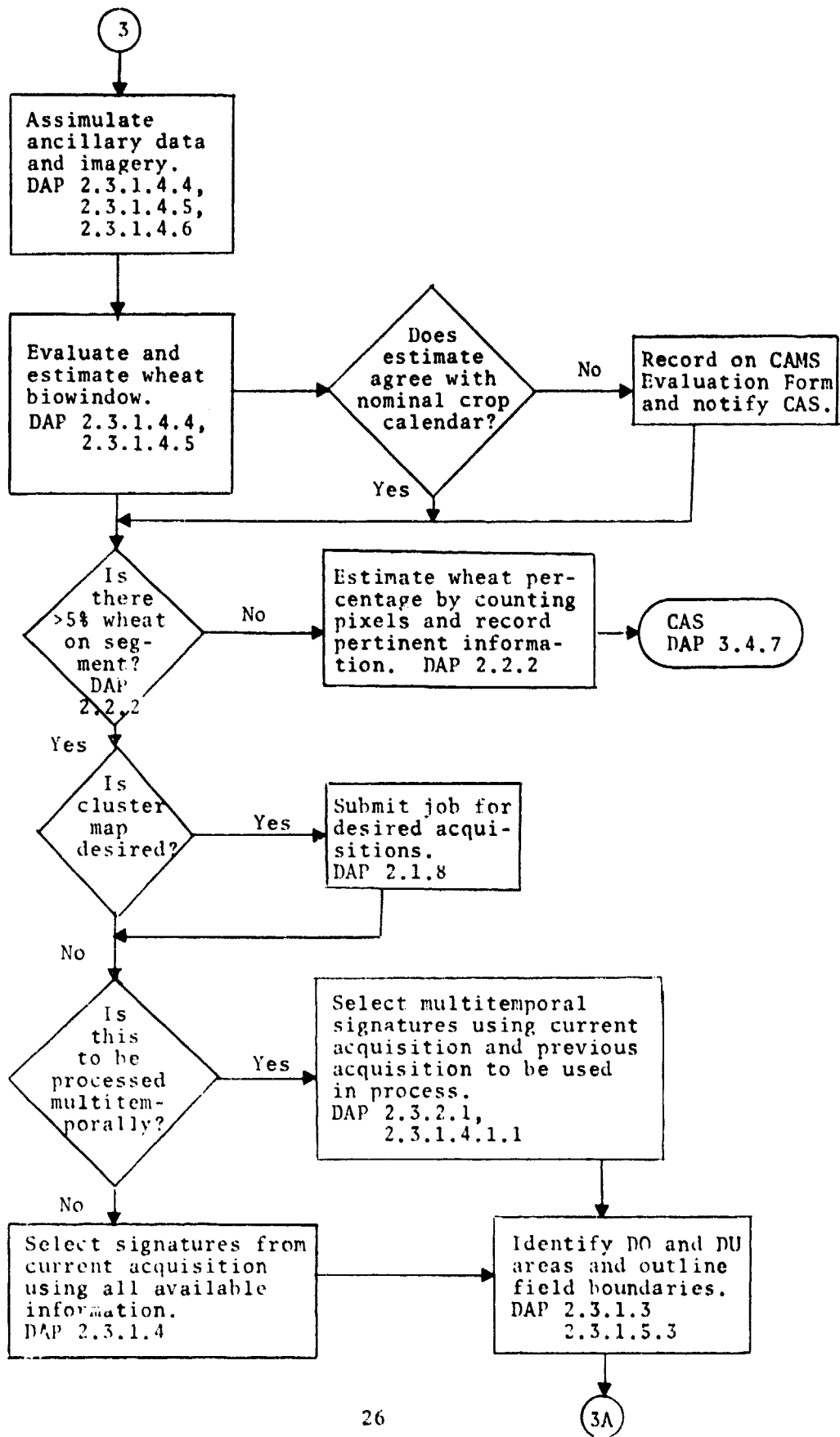


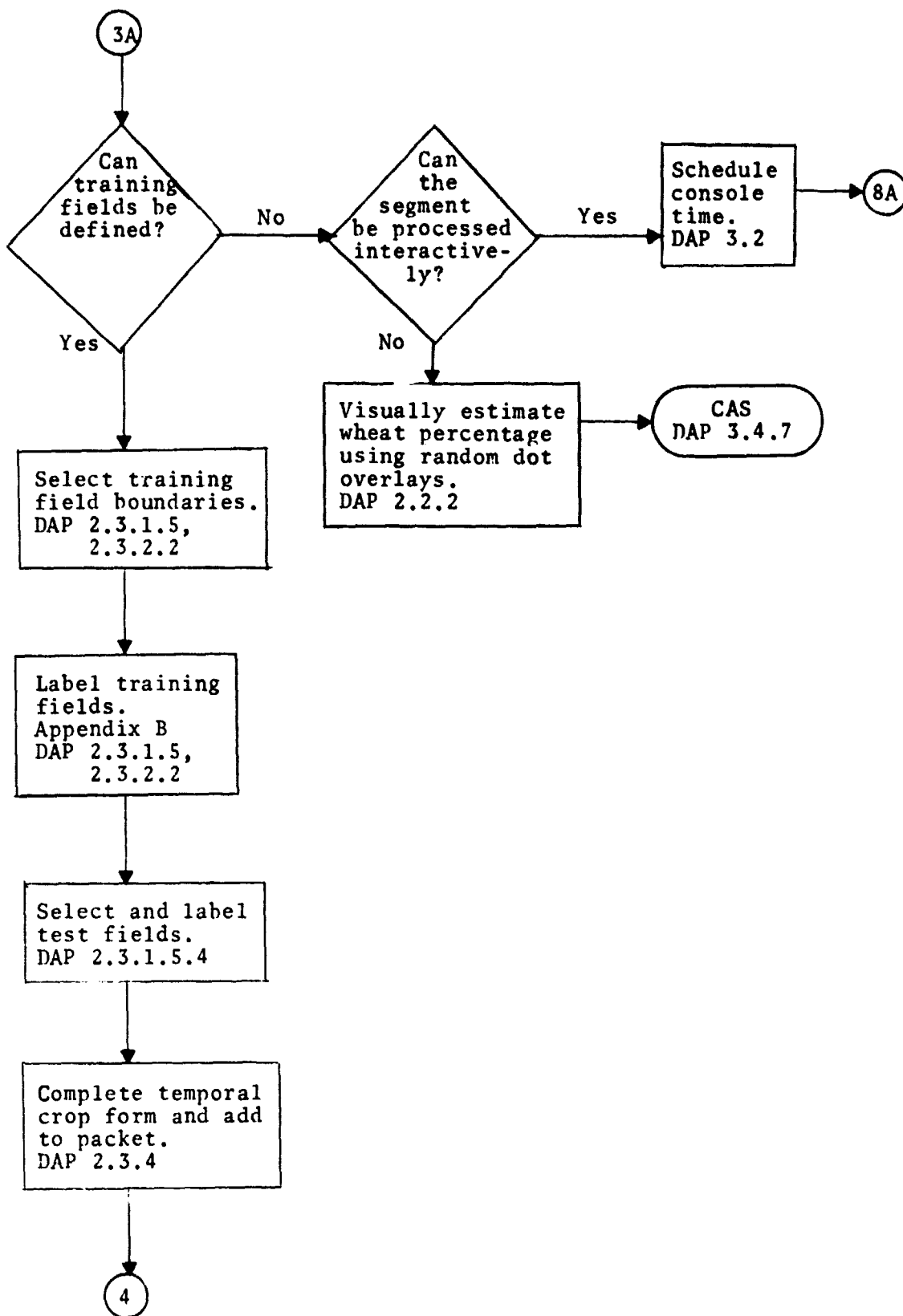
3.0 DETAILED FLOW CHARTS

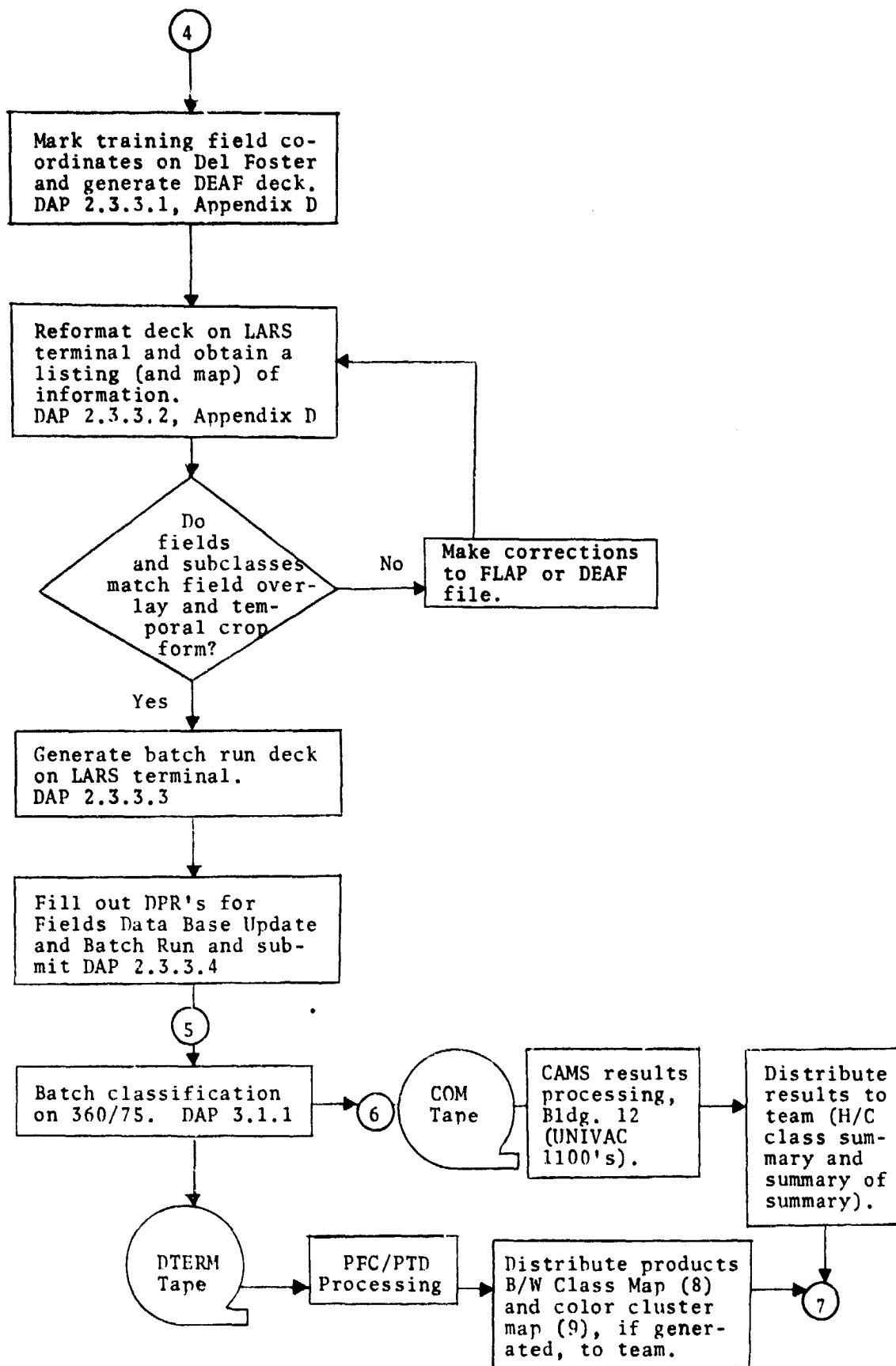
These charts emphasize the decision points and sequence in the flow of a segment through CAMS. Each major block is cross-referenced to the section of the Detailed Analysis Procedures which applies to it.

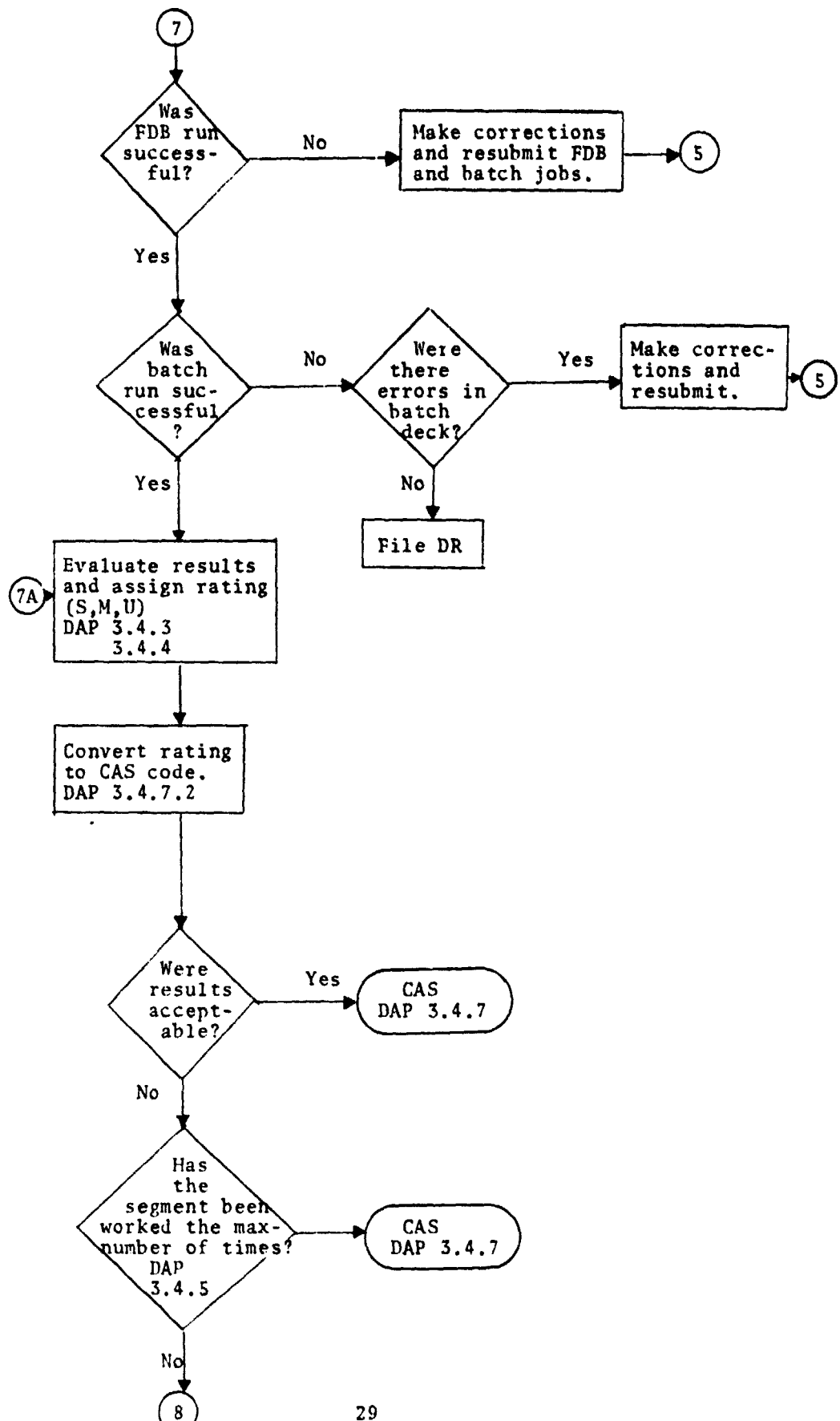


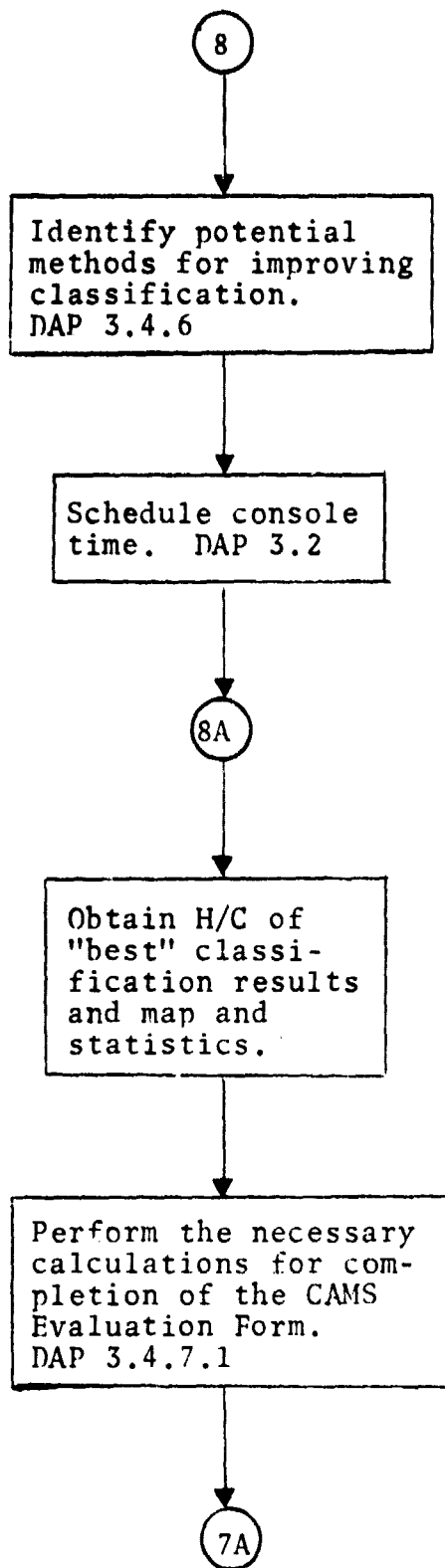












4.0 DETAILED ANALYSIS PROCEDURES SECTION TITLES

1.0 Introduction

2.0 Image Interpretation Procedures

2.1 Imagery Review

2.1.1 Checklist of Segment Packet Contents

2.1.2 Quality Evaluation of Packet Contents

2.1.3 Imagery Preparation

2.1.4 Location of Segment

2.1.5 Familiarization with Background Data

2.1.6 Review for Determination of Wheat Estimate

2.1.7 Review for Significant Change in Wheat Estimate

2.1.8 Cluster Map Generation

2.2 Processing Mode Selection

2.2.1 Acquisition Selection

2.2.2 Low Wheat Segments

2.2.3 Multitemporal Decision for Computer Classification

2.3 Training Field Selection

2.3.1 Single Acquisition

2.3.1.1 Analyst Decision Criteria

2.3.1.2 Imagery Overlay Preparation

2.3.1.3 Exclusion Area Definition

2.3.1.4 Training Field Identification

Criteria

2.3.1.4.1 Signature Identification

2.3.1.4.1.1 Cluster Map Usage

2.3.1.4.2 Minimum Field Size

2.3.1.4.3 Minimum Category Size

2.3.1.4.4 Use of Nominal Crop Calendar

2.3.1.4.5 Use of Adjustable Crop Calendar

2.3.1.4.6 Use of Crop Reporting Unit Statistics

2.3.1.5 Signature Labeling and Boundary Delineation

2.3.1.5.1 Wheat

2.3.1.5.2 Non-wheat

2.3.1.5.3 Exclusion Areas

2.3.1.5.4 Test Fields

2.3.1.5.5 Fallow Overlay

2.3.1.5.6 Special Cases

2.3.1.5.7 Polaroid Documentation

2.3.2 Multitemporal

2.3.2.1 Signature Identification

2.3.2.2 Signature Labeling and Boundary Delineation

- 2.3.3 Mechanical Preparation for Automatic Data Processing
 - 2.3.3.1 Corner Coordinate Recording
 - 2.3.3.2 Reformatting and Editing
 - 2.3.3.3 Reformatting User ID Card for Field Update
 - 2.3.3.4 Batch Run Deck Generation
 - 2.3.3.5 Job Submittal
- 2.3.4 Post Interpretation Procedures
- 2.4 Training Field Revision
 - 2.4.1 Single Acquisition Classification
 - 2.4.2 Multitemporal Classification
 - 2.4.3 Mechanical Preparation for Automatic Data Processing
- 3.0 Data Processing Procedures
 - 3.1 Batch Run Procedures
 - 3.1.1 Batch Input Card Formats
 - 3.1.2 Examples
 - 3.2 Interactive Run Procedures
 - 3.2.1 Software Considerations
 - 3.2.2 Post-processing and Interface
 - 3.3 Procedures for Special Cases
 - 3.4 Evaluation Procedures
 - 3.4.1 Products Essential for Evaluation
 - 3.4.2 Evaluation Flow Procedures
 - 3.4.3 Evaluation Criteria

3.4.4 Criteria for Rework

3.4.5 Problem Detection Guidelines

3.4.5.1 Classification Map

3.4.5.2 Thresholding

3.4.5.3 Training Field Accuracy

3.4.5.4 Test Fields

3.4.5.5 Imagery and Field Overlay

3.4.5.6 Statistics

3.4.5.7 Clustering Report and Map

3.4.6 Results Archival and Transmittal

3.4.6.1 CAMS Evaluation Form

3.4.6.2 CAMS Evaluation Codes

Appendix A – Imagery Quality Control

A.1 Histogram Problems

A.2 Pixel Definition

A.3 Abutment Problems

A.4 Data Dropouts and/or Skips

A.5 Grid Problems

A.6 Total Number of Pixels and Scan Lines

A.7 Photo Processing and Film Problems

A.8 Verification of Temporal Registration

A.9 Clouds, Shadows and Haze Evaluation Criteria

Appendix B - Coding Standards

B.1 LACIE Field Data Coding

B.2 Change Code Designations

Appendix C - Equipment

C.1 Image Interpretation Equipment

C.2 Console Operations

Appendix D - Corner Coordinate Recording, Reformatting and Editing Procedures

D.1 Corner Coordinate Recording

D.2 Fields Data Conversion and Editing on the LARS Terminal

D.3 Batch Post-Processing of CAMS Report Fiche

Appendix E - Processor Capabilities

E.1 Computation of Statistics

E.2 Modification of Statistics

E.3 Feature Selection

E.4 Classification

Appendix F - Glossary

Appendix G - References

5.0 REFERENCES

1. CAMS Pre-April Operator Plan for LACIE Phase II, LEC-7314, November, 1975.
2. CAMS Phase II Detailed Analysis Procedures (preliminary version) LEC-7673, January, 1976.